Regional Operational Plan CF.3A.13.01

Operational Plan: Yukon River Summer Chum Salmon Radio Telemetry Studies

by

Bonnie M. Borba,

Stephanie N. Schmidt,

Jan M. Conitz,

and

Sean D. Larson

December 2013

Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	log_2, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

REGIONAL OPERATIONAL PLAN CF.3A.13-01

OPERATIONAL PLAN: YUKON RIVER SUMMER CHUM SALMON RADIO TELEMETRY STUDIES

by

Bonnie M. Borba
Alaska Department of Fish and Game, Division of Commercial Fisheries, Fairbanks

Stephanie N. Schmidt
Alaska Department of Fish and Game, Division of Commercial Fisheries, Anchorage

Jan M. Conitz
Alaska Department of Fish and Game, Division of Commercial Fisheries, Anchorageand

Sean D. Larson
Alaska Department of Fish and Game, Division of Commercial Fisheries, Anchorage

Alaska Department of Fish and Game
Division of Commercial Fisheries

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Bonnie Borba,
Alaska Department of Fish and Game, Division of Commercial Fisheries,
1300 College Road, Fairbanks, Alaska 99701-1599, USA

Stephanie N. Schmidt, Jan M. Conitz, and Sean D. Larson
Alaska Department of Fish and Game, Division of Commercial Fisheries
333 Raspberry Road, Anchorage, AK 99518-1599, USA

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SIGNATURE PAGE

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Approval

Title	Printed Name	Signature	Date
Project leader	Stephanie N. Schmidt	Stephanie N Schmidt	12/20/13
Biometrician	Toshihide Hamazaki	[signature]	12/20/13
Research Coordinator	Jan M. Conitz	[signature]	12-20-2013

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PURPOSE

This radio telemetry project on summer chum salmon was initiated to determine distribution to important spawning areas, run timing, migration patterns, and stock composition within the Yukon River drainage. Fishery management is primarily based on the estimated passage provided by the mainstem sonar on the Yukon River operated at Pilot Station at river mile 123. The escapement of summer chum salmon in the Anvik River, a tributary of the Yukon River at river mile 317, is also monitored using sonar and is used as an index for the remainder of the Yukon River drainage. From 1993 through 2002, summer chum salmon escapement in the Anvik River represented 46%, on average, of the total run estimate based on the mainstem sonar project at Pilot Station and harvest below the sonar, but from 2003 through 2012 the average proportion dropped to 23%. An important objective of this radio telemetry study is to reevaluate where the summer chum salmon stocks are distributing. Additionally, with the recent low returns of Chinook salmon, fishing pressure has increased on summer chum salmon throughout the run for subsistence and commercial fisheries. Timing of these fisheries with respect to different stocks entering the Yukon River needs to be evaluated. Finally, a drainagewide summer chum salmon escapement goal is needed, and estimates provided through this project will contribute to the analysis for that goal.

BACKGROUND

The subsistence fishery in the Yukon River drainage is one of the largest in the state and the importance of summer chum salmon (*Oncorhynchus keta*) in the fishery is increasing. Declines in Chinook salmon and restrictions on subsistence fishing opportunity have resulted in Chinook salmon harvests below the Amount Necessary for Subsistence in recent years (Jallen et al. 2012). Subsistence and commercial fishermen are increasingly targeting other species of salmon, including summer chum, to supplement, or in some cases, replace Chinook salmon harvest. Furthermore, market conditions have improved for a productive summer chum salmon commercial fishery, providing a much needed economic opportunity to one of the poorest areas of Alaska. In the Yukon River drainage, commercial fishing on summer chum salmon helps pay for the supplies necessary to subsistence fish and hunt, including gas and fishing gear (Jallen et al. 2012).

Summer chum salmon returns, while variable, have not experienced the declines of Chinook salmon. Estimates of returning summer chum salmon in 2011 were over 1.9 million fish, and the historical average during 1997-2010 was over 1.5 million fish (JTC 2012). However, numerous spawning tributaries on the Yukon River lack adequate escapement estimates for summer chum salmon and their distribution among spawning areas in major and minor tributaries is poorly understood. Increased effort in aerial surveys for summer chum salmon has not produced sufficient and reliable information to address these data gaps. The size of the Yukon River drainage, extensive network of tributaries, and lack of a road system severely hinders intensive ground surveys, while weirs and counting towers are often inhibited by unfavorable river conditions. Currently, annual abundance estimates necessary for management are tenuously based on the variable relationship between Pilot Station sonar and Anvik River sonar counts. Furthermore, the chum salmon genetic baseline does not provide for discrimination between various lower Yukon River chum salmon stocks in mixed stock analysis; it is most useful determining U.S./Canada stocks and summer/fall runs.

Work from 1996 to 2001 demonstrated that large-scale radio tagging studies of fall chum salmon in the Yukon River basin were feasible (JTC 1996, 1998; Spencer et al. 2003) and large-scale telemetry studies in 2002-2004 have provided valuable information on run characteristics of Chinook salmon in the Yukon River basin (Eiler et al. 2004, 2006a, 2006b). A small feasibility radio tagging study was conducted on summer chum salmon in the Yukon River in 2004 and was found to be relatively successful (Spencer and Eiler 2007). The radio telemetry project proposed here would provide intensive escapement monitoring and stock composition information that are urgently needed for fishery managers to balance competing goals of ensuring adequate escapement for long-term sustainability and maximizing yield.

Summer chum salmon are rapidly growing in importance as a subsistence and commercial resource in the Yukon River. Chinook salmon returns have decreased by more than half in the last 20 years; in the last five years the total return averaged just 144,000 fish. Directed commercial fishing on Chinook salmon has not occurred since 2007, and 2011 and 2012 saw unprecedented restrictions on subsistence fishing for Chinook salmon. Summer chum salmon returns have not experienced the same decline as Chinook salmon, but long-term sustainable management will be crucial as commercial and subsistence fishing effort shifts to summer chum salmon.

Implementation of this project will greatly assist in the conservation and management of Yukon River summer chum salmon by collecting essential information to estimate stock composition, run timing, movement patterns, spawning distribution, escapement, and total abundance. As an example of the critical information need for management, the current commercial fishery in the Lower Yukon Area has been shifted to the later portion of the summer chum salmon run to provide commercial harvest opportunity on an abundant species while conserving Chinook salmon. However, lack of information prevents managers from giving full consideration to timing and relative exploitation of individual summer chum salmon stock components. This project will provide information representing specific stock components of the run, and will help identify where additional escapement or monitoring projects may be most effective. Having more stock specific information will enable management to better account for different stocks when implementing harvest strategies.

This project is the first major effort to estimate summer chum salmon run timing, distribution, and abundance drainagewide, with consideration for specific stock components. An established network of radio telemetry receivers will be utilized to track summer chum salmon movements in the mainstem Yukon River from the tagging site near Russian Mission into tributaries and spawning areas. Additionally, aerial surveys will be conducted to locate and track tagged fish in otherwise unmonitored reaches of the mainstem river, tributaries, and spawning areas. Although tagging sufficient fish in a population of more than one million is challenging, the ability to track individual tagged fish throughout their migration will provide precise and detailed information that will be used for a variety of estimates. Basic mark-recapture assumptions will be tested; precise location of all detections of tagged fish will be mapped; travel time along different sections of the river will be estimated; and proportions of the total marked population recovered in different tributaries will be determined. Drainagewide abundance and escapement above the tagging site will be estimated, and stratified mark-recapture models will be used where possible to estimate abundance and run timing parameters for tributary specific populations.

OBJECTIVES

1. Estimate stock specific run timing, migration rate, movement patterns, and distribution of summer chum salmon.
2. Identify important spawning tributaries and establish a stock composition baseline based on relative escapements to monitor stock productivity over time.
3. Identify migration routes and spawning areas that need to be added to the anadromous water catalog.
4. Attempt to estimate drainagewide escapement of summer chum salmon by estimating abundance and run timing parameters for major tributaries or stock groups, using a stratified Darroch model or a maximum likelihood model.
5. Evaluate the robustness of the Anvik River sonar relationship to total run estimate, based on Pilot Station sonar and harvest below the sonar, as an indicator of population abundance.

METHODS

FIRST YEAR

Preparations

Year one of this project (2013 field season) was spent preparing for the radio telemetry tagging and tracking operations that will occur in the second year (2014 field season). Radio telemetry towers and receivers are already in place at most of the sites important for summer chum salmon tag recovery, which comprise most sites below Rampart Rapids that were used in the 2000-2004 Chinook salmon radio telemetry project (Eiler 2006b). However, most of this receiver array has had minimal use since 2004, with the exception of a few towers used for whitefish and sheefish studies, and the Tanana River array used for a fall chum salmon study in 2007-2008. Towers were accessed by helicopter and landing zones were recleared of brush for access to the tower sites; equipment on each tower was checked, repaired, and replaced as needed. Land use permits, where required for tower and camp sites, are being updated or sought. All on-site work must be done during summer months after ice out on the river, and timing will overlap substantially with the summer chum salmon run, which precluded tagging and tracking operations during the first year. Other preparations include barging an ADF&G project boat, fishing supplies, and camp gear down to Russian Mission during summer 2013, to be sure all equipment is in place and ready to use for start of tagging in June 2014.

Position descriptions have been written and followed through the state system until approval is achieved for two new positions required for this project. A Fish and Wildlife Technician III position was hired; this position, along with the Fish and Wildlife Technician IV and Fishery Biologist II, will lead tagging operations. A College Intern III position with a training plan was also created, and the incumbent has been creating a database in SQL Server 2008 and interfacing with the existing MS Access database to handle data requirements of this project. The college intern works closely with ADF&G regional information technology (IT) staff.

Local fishermen from Russian Mission or nearby communities will be contracted before the start of the 2014 season to operate the boat and fishing gear, capture fish for tagging, and assist with tagging and data collection. Organizations have been contacted, including the Russian Mission Iqurmuit Traditional Council, Russian Mission City Council and Russian Mission Native Corporation to solicit interest. Traditional knowledge of fishing sites and experience operating and mending drift gillnet gear in the Yukon River is essential to the success of the project. Use of a fish wheel for capture is not anticipated because it is not the normal fishing gear in this portion of the drainage and local experience operating them is minimal. Methods planned for the summer chum salmon capture and tagging operations are similar to those used in the summer chum salmon study conducted in 2004 (Spencer and Eiler 2007).

Outreach to local communities for support of the project has begun and will continue through the numerous fishermen's meetings that occur in the Yukon River drainage. Tribal and Traditional councils are being actively contacted in Russian Mission and other communities located at or near project sites to explain and seek support for the project.

One thousand two hundred pulse-coded radio transmitters in the 150-151 MHz frequency range were ordered from Advanced Telemetry Systems[1]. Tag size was determined based on previous studies conducted on chum salmon in the Yukon River and the selected tag model is F1840B (see following section on selection of tag type).

Selection of Tag Type

Considerations for tag type selection include tag size, which is affected by the size of battery required for the length of the study to be conducted, fish size, and length of the migration remaining. Internal radio tags were deployed in chum salmon on the Toklat River (river kilometer-rkm 1,355) during the fall run of chum salmon in 1997 (Holder and Fair 2002). Initial internal tag size was 5.2 cm long, 1.8 cm in diameter, with a 30 cm transmitting antenna. Issues arose with stomach ruptures, observed on internal examination of the fish, and tags were subsequently modified for external application. The researchers speculated that the changes occurring to the maturing salmon this far into the migration (tagged 44 rkm from primary spawning grounds) resulted in a hardening or loss of elasticity in the stomach tissues as resources were being reabsorbed and used to make the journey and for gamete production.

In 1998 and 1999 fall run chum salmon were internally tagged at the Rampart Rapids (mainstem Yukon rkm 1,169; John Eiler, Fishery Research Biologist, National Marine Fisheries Service, Auke Bay Laboratory, Juneau; personal communication). The tags used in that study were of dimensions 5.1 cm in length with a 30 cm transmitting antenna, 2.0 cm in diameter, and 20 g in weight. These chum salmon were tagged more than 400 rkm from the nearest major spawning ground on the Chandalar River, and the most distant stock migrated as far as 1,680 rkm to Teslin Lake.

In 2004, a feasibility study was conducted on summer chum salmon in the lower Yukon River (Spencer and Eiler 2007) using tags of the same dimensions (5.4 cm long, 2.0 cm diameter, 20 g) as those deployed in Chinook salmon (Eiler et al. 2006b). A high proportion, over 41%, of the tags deployed in the 2004 study were later located downstream of the Paimiut gateway towers by boat and aerial surveys, indicating that tagging interfered with their migration. The large tag size could have caused mortality or tag regurgitation; however, handling, predation, unreported harvest, tag malfunctions, or entry into local spawning tributaries could also have produced these

[1] Advanced Telemetry Systems, Isnati, Minnesota. Use of this company name does not constitute endorsement, but is included for scientific completeness.

results. In 2007, a feasibility study was conducted that investigated three tag sizes to be used on fall chum salmon in the Tanana River at rkm 1,280, with an anticipated spawning distance of 369 rkm upstream of tagging site (Bonnie Borba, Yukon Area Commercial Fisheries Biologist, ADF&G, Fairbanks; personal communication). The tag selected for release in female fall chum salmon in 2008, to determine mainstem spawning in the Tanana River, was bottle shaped (tapered neck), 5.6 cm long by 1.7 cm in diameter with a 30 cm transmitting antenna, and weighing 22 g. The diameter was optimal to minimize regurgitation and rupturing in the female fall chum salmon. While the tag was longer than other tags tested, length of the tag is a result of battery size and a longer battery life was needed for the fall chum study.

Summer chum salmon are slightly smaller than fall chum salmon (Paired t-test, $P < 0.001$; about 575 to 596 mm average length from mid-eye to fork of tail; lower Yukon test fish project data 1981-2012) and about one pound less on average (commercial fishery data). Males are typically larger than females in both runs of chum salmon. However, the average length difference due to sexual dimorphism is twice as large in summer chum salmon as in fall chum salmon (18 mm in summer vs. 9 mm in fall chum salmon; Paired t-test, $P < 0.001$). Although advances in tag technology have produced smaller tags with increased battery life compared to those used in previous Yukon River studies, smaller is not always suitable. Small tags can be more easily regurgitated, while larger tags can cause ruptures of the stomach. Due to the smaller size of summer chum salmon, tags used for female fall chum salmon in the 2008 Tanana River study will be used. A smaller diameter tag with a longer battery life is optimal for tracking needs for this project and should reduce the possibility of regurgitation or rupturing in summer chum salmon. The selected tag model is F1840B (Advanced Telemetry Systems).

SECOND YEAR

Field Components

Description of Study Area

The study area includes the Yukon River drainage from Russian Mission (rkm 340), upstream to, and including, the Tanana River system through rkm 1,694. Stations are located on important migration corridors and spawning tributaries. A total of 33 remote tracking stations will be utilized throughout the study area (Appendix A1), including two stations located short distances downstream and upstream of the tagging site. The downstream station will track any downstream migration, as well as "dropout" (i.e. fish that do not migrate upstream after tagging). The first upstream towers are gateway stations used to determine which tagged fish successfully move upstream after tagging and can be considered part of the marked population.

Russian Mission is the closest community that will be affected by the project. Several important geographic and fishery factors make this location ideal for tagging. It is beyond where the major portion of the summer chum salmon subsistence and commercial harvests are taken (about 63% and 65%, respectively, in 2012), so tag loss to harvest should be minimal. The morphology of the river is conducive to efficient capture of salmon for tagging because this location is confined to one, relatively narrow channel. The Pilot Station sonar can be used to monitor daily passage and sufficiently characterizes the temporal distribution of the run to estimate daily tagging effort needed. Finally, escapement for the major spawning tributary below Russian Mission, the East Fork Andreafsky River, is monitored with a weir, providing an index of lower river escapement outside the mark-recapture study area. A previous Chinook salmon radio telemetry study on the Yukon River was moved to Russian Mission for these same reasons and was successfully executed (Spencer et al. 2006). Standard ADF&G climatological data will be collected daily at the established tagging camp, including water and air temperatures, proportion cloud cover, level of precipitation, and wind direction and velocity (Appendix A2).

Fish Capture

One or more local village organizations, including the Russian Mission Iqurmuit Traditional Council and Russian Mission Native Corporation, have been contacted to solicit public interest in the project and local fishermen will be contracted before the 2014 season to assist with tagging operations. Two captains will each operate a boat with a crew member to fish the sites and will be responsible for deploying and retrieving the nets and for safe skiff operation and local knowledge of fishing areas. Two technicians will be hired by ADF&G, whose primary responsibility will be to properly handle and tag all fish to minimize handling effects and meet mark-recapture assumptions. They will also train and oversee the local fishermen on fish handling, tagging, and data collection, and assist with fish capture, rotating between the two crews. Each crew will fish up to 7.5 hours per day, seven days per week, for approximately seven weeks during the summer chum salmon runs in 2014 and 2015[2]. Net configurations will consist of 4.5" and 4.25" mesh size, 10 fathoms in length shackled together as needed based on abundance, 7.6 m deep gillnets hung at a 2:1 ratio, and constructed of thicker and softer #21 seine twine to minimize injuries. Drifting methods will follow those used in the feasibility study conducted by Spencer and Eiler (2007).

Tagging

To ensure the summer chum salmon are tagged in proportion to the magnitude and timing of the run, a 5-week radio tagging schedule has been developed using historical run timing from the Pilot Station sonar project. This schedule is expected to cover over 95% of the run during a full season of deployment (Appendix A3). A total of 1,200 radio tags and secondary markers will be deployed each year of tagging operations. The inseason run timing information from the Lower Yukon River test fishery project in Emmonak and run timing at Pilot Station sonar may be used to modify the deployment schedule as the season progresses. All salmon will be cut from the net and only the first four summer chum salmon collected from each drift will be transferred directly to the project boat for processing using a dip net. Every effort will be made to live release any additional fish. The four fish will be evaluated and a maximum of three, with no major or bleeding injuries, that are judged healthy will be tagged. Fish with major wounds will not be tagged but either released alive or kept for subsistence use. The selected fish will be placed in a cradle submerged in a water tank. The water tank will be continuously re-supplied with fresh river water using a 12-volt battery powered bilge pump. The additional fish selected for tagging will also be held in a flow through water tank on board. All fish will be handled as gently as possible to minimize stress. Handling time for tagging, once the crew is trained, is approximately two minutes per fish. The fish will be measured for length to the nearest millimeter from mid-eye to fork-of-tail and evaluated for overall condition. Each fish will be given a secondary external mark: a unique and sequentially numbered white spaghetti tag sewn through the musculature at the base of the dorsal fin. Other mark-recapture projects taking place in the Yukon River

[2] Note that 2015 operations will be contingent upon continuation of AKSSF funding through Phase II of the project.

drainage – the Koyukuk River summer chum mark-recapture project in 2014 and the Yukon Chinook mark-recapture project scheduled for 2015 – are using colors other than white for secondary tags (refer to Appendix 10 for list of colors in other projects). Finally, the fish will be tagged with a pulse-coded radio transmitter (Eiler 1995) in the 150-151 MHz frequency range by insertion through the mouth and into the stomach, using a plastic tube, until no longer visible. All tagged fish will be released back into the water over the outside edge of the boat immediately after sampling.

The radio tagging crew will record effort and catch data obtained during sampling. Nets will be marked in increments (half or quarters) to determine length of net out when not deploying the full length of net during peak passage. Total number of Chinook, summer chum, and other fish species caught will be recorded, as will the number of summer chum salmon released untagged. External tag color and/or number from chum salmon that are recaptured will be recorded. For each tagged summer chum salmon, the following will be recorded: the degree of coloration, visible healed scars, mid-eye to fork of tail length, external tag number, radio tag frequency and code, identity of the person tagging the fish, latitude, longitude, date and time of release, and qualitative comments about the fish (Appendix A4). Feasibility of taking weight or girth from tagged fish or a subsample of non-tagged fish will be determined in the first year of the study. Either weight or girth would be used as a measure of fitness based on correlation with length. If taking both weight and girth increases handling time significantly or is detrimental to fish, then a determination will be made as to which measurement is most needed as an indicator of fitness. Girth in mm is taken just before the dorsal fin. Scale sampling for age determination was not included to reduce handling time. Capture and tagging data will be edited and entered daily into an Excel spreadsheet and sent electronically to Fairbanks for the database manager to upload and incorporate with data from the remote tracking stations.

Remote Stationary Tracking

Remote tracking stations (RTS) will record both downstream and upstream movements of the radio-tagged salmon (*Objective 1*; Eiler 1995). The first RTS are placed within 42 rkm to the tagging site both downstream and upstream to monitor the initial movements after tagged fish are released (noted on map; Appendix A1). The RTS consist of several integrated components including a computer-controlled receiver, satellite uplink, and self-contained power system. Radio-tagged fish within reception range of the stations are identified and recorded. Information collected includes the date and time the fish are present at the site, the signal strength and activity pattern of the transmitter (active or inactive), and the location of the fish in relation to the station (i.e., upriver or downriver from the site). Information on station operations (i.e., voltage levels for the station components, and whether the reference transmitter at the site is being properly recorded) is also collected. Because the sites are located at remote locations, the collected telemetry data are transmitted every hour to a geostationary operational environmental satellite (GOES) and relayed to a receiving station near Washington D.C. (Appendix A5). Satellite information is downloaded hourly into a computerized database for analysis. Prior to station activation, the receivers and satellite uplinks will be tested in Fairbanks to evaluate performance. The stations are activated before the field season by accessing the sites via helicopter to install the electronics and repair any damages that had occurred over winter. The stations are deactivated after the field season by removing the electronics via helicopter.

Aerial Tracking

Aerial surveys are necessary to further determine the movement patterns and final fate of radio-tagged fish, particularly those in non-terminal mainstem areas and in otherwise unmonitored reaches (*Objectives 1 – 3*). Tagged salmon will be located from fixed-wing aircraft and helicopters equipped with 4-element yagi type receiving antennas to document the movements of the fish as they progress to the spawning areas (Appendix A6). Because of the increased strength of the signal when not in water, tags located in association with villages or fish camps can be distinguished and will be noted as caught but not returned. The radio tags will also have an inactivity signal that will emit if the tag remains stationary for 12 and 24 hours. The final inseason choice of tributaries and mainstem flight patterns will be based on the distribution pattern observed for the tagged sample. Aerial survey areas would include the Yukon River mainstem to try and determine the status of radio-tagged fish as they progress in the migration. Aerial surveys will also be conducted by ADF&G and other agencies in various tributaries to further locate and verify spawning areas. Tributaries without remote tracking stations would be surveyed if they were located near the last recorded location for a number of tagged fish. Boat tracking will also be used near the tagging site to locate possible regurgitated tags, which are usually found within proximity to the event.

Tag Recovery

Informational packets/posters describing the study and emphasizing the importance of reporting tag recoveries will be sent to tribal and governmental representatives in all villages in the drainage. If inseason biological sampling of Yukon River subsistence salmon harvests is conducted in communities throughout the drainage by other non-governmental organizations such as the Association of Village Council Presidents and private contractors, these personnel will assist with radio tag recovery. Radio tags recovered from the public or projects that can be retrieved in a timely fashion will be sent back to the tagging camp for redeployment. After the season, a small incentive reward such as a hat with project logo will be sent to each participant, along with entry into an area wide raffle for a monetary prize. Participants who return radio or spaghetti tags will also receive a complete report on each tagged summer chum salmon they submitted, including where and when those fish were tagged and travel distances and rates to recovery sites.

Data will be collected from all remote tracking stations, which will provide passage data for tagged fish at specific locations in the migration including major tributaries. Radio transmitters will be recovered at various run assessment sites (Appendix A7) and opportunistically from subsistence and commercially captured fish (Appendix A8). Second event sampling data will include fish being examined for tag loss and information about the final fate of tagged fish. Assessment projects collecting complete fish count or passage data will also provide the number of summer chum salmon in the second event sample. Although sex cannot be determined accurately at the tagging location, it will be included on recovery forms because maturation near spawning grounds makes sex more evident. Agencies operating salmon escapement and monitoring projects in the Yukon River drainage will be contacted and supplied with data collection forms and instructions for examining summer chum salmon for external marks and for recovering radio tags (Appendix A9 and Appendix A10). Anticipated projects monitoring salmon escapement upstream of the tagging site at Russian Mission include: the Anvik River sonar/counting tower site along with placement of an additional receiver at the site for complete coverage of tagged fish to be compared with the sonar estimate (rkm 507, from mouth of

Yukon); Gisasa River (rkm 1,046) and Henshaw Creek (rkm 1,809) weirs in the Koyukuk River drainage; Chena River sonar/counting tower (rkm 1,481) and Salcha River counting tower (RK 1,553) in the Tanana River drainage. Funds will be sought to operate the Salcha River counting tower into mid or late August (beyond Chinook salmon season) to get a more complete representation of chum salmon passage. Additional monitoring projects include capture and live release from the video test fish wheels at Rampart-Rapids on the mainstem Yukon River (rkm 1,169) and near Manley on the Tanana River (rkm 1,224). East Fork Andreafsky River weir (rkm 208) is also monitored downstream of the tagging site and will assist should marked fish move downstream past the lower gateway and enter this large tributary. Test drift gillnet fisheries will also be occurring downstream of tagging in Emmonak (rkm 38) and Pilot Station (rkm 197), and upstream at Eagle (rkm 1,931) and near Manley Hot Springs (rkm 1,224).

Data Analysis and Reporting

Although data entry will occur as data are collected through the tagging and tracking phases, final data analysis for reporting will be conducted at the conclusion of this project.[3] Each record of a tagged fish must be examined to verify its status. Millions of records will be generated from each of the towers and hundreds of thousands of records will be generated from each of the aerial/ground surveys. A database in SQL Server Express 2008 will be interfaced with the current MS Access database to achieve a particular level of data summarization. Many factors go into determining the final fate of each fish through the migration and the various points the fish is detected. Queries of this large database will be used to summarize the data for stock timing, migration rates, and proportion of spawners to final locations in spawning areas, taking in account harvests along the route. Additionally, a comparison of the catch per unit effort (CPUE), (Appendix A11) representing relative run abundance, and the number of tags deployed daily will be generated to evaluate the effectiveness of the tag application. Cumulative length frequency distribution of radio tagged salmon will be compared with the distribution from samples collected at various projects to test for homogeny using Kolmogorov-Smirnov (K-S) two sample tests.

Data Analysis

Catch Per Unit Effort

CPUE for each drift is calculated as:

$$CPUE = \frac{C}{(t\ x\ f)} \tag{1}$$

where *C* is the number of chum salmon captured, *t* is fishing time in hours, and *f* is net length in fathoms. The following formula is used to determine, *t*, drifting time:

$$t = \left[\frac{set\ time + retrieval\ time}{2}\right] + soak\ time \tag{2}$$

To provide an estimate of chum salmon passing the tagging sites, a CPUE for day *d* is calculated as:

---

[3] Project may operate for one, two, or more years, depending upon continuation of AKSSF or other funding following successful first year of data collection.

$$CPUE_d = \frac{\sum c}{f(\sum t)} \qquad (3)$$

where c is the number of chum salmon captured, t is fishing time in hours (as defined in equation 2), and f is net length in fathoms, for all drifts made that day.

Mark-Recapture Abundance Estimation

The mark-recapture data will first be examined for any evidence of failure to meet mark-recapture assumptions. Tagged fish that did not move above the gateway receiver, that moved and remained downstream of the tagging site, or that were recorded as mortalities will be censured from the marked population. Evidence of tag loss, provided by observation of secondary marks in fish with no radio tag at weirs and other monitoring sites, will be examined and a correction applied if tag loss of more than a few percent is observed.

In addition to assumptions and requirements for closed populations, the basic two-sample Petersen mark-recapture model relies upon assumptions of equal capture probabilities in marked and unmarked fish (Seber 1982, p.59; Pollock et al. 1990). At least one of the following three conditions must be met: 1) all fish have an equal probability of capture in the first sample (tagging); 2) all fish have an equal probability of capture in the second sample (recovery); and 3) fish mix completely between the first and second samples. However, the natural variation inherent in salmon migrations and spawning escapements presents many possibilities for capture probabilities to vary. Spawning migrations may last a month or more, during which daily immigration and mortality rates and other biological parameters can vary substantially. The summer chum salmon run within the Yukon River drainage presents even more complexity, being composed of different stocks which migrate into different tributaries and have different migration timing, migration routes, migration distances, travel rates, and physical status at the tagging site. Stratified mark-recapture models are widely used to help account for such variation and complexity. These models extend the two-sample Petersen model over two or more sampling events in both the first and second samples and allow some parameters to vary over these temporal or spatial strata (e.g. Arnason et al. 1996). These models can also be used to test the assumptions for equal capture probability.

Mark-recapture data will be compiled into tagging strata, based upon peak periods or pulses of the summer chum salmon run passing the Pilot Station sonar, and recapture strata based on tributary monitoring location. Only monitored locations with full summer chum salmon counts can be used for recapture sample data. Contingency tables using a chi-square statistic for goodness-of-fit will be used to test for equal probability of capture in tagging and recapture sampling among all strata (Seber 1982; Arnason et al. 1996).

If the evidence does not indicate that equal capture probability assumptions were violated, then data from all tagging and recapture strata can be pooled. In this case, drainage-wide abundance above Russian Mission will be estimated using Chapman's closed population two-sample, mark-recapture estimator (*Objective 4*; equation 4; Seber 1982). This estimation was employed successfully for the Yukon River Chinook radio telemetry project conducted at the same site (Spencer et al. 2006).

$$N = \frac{(C+1)(M+1)}{R+1} - 1 \qquad (4)$$

where: N is the estimated fish abundance passing upstream of Russian Mission, M *is* the number of fish marked that successfully went upstream of Russian Mission, C is the estimated number of fish “inspected” at on-the-ground escapement monitoring projects (i.e. weirs, etc.); and *R* is the number of marked fish recaptured among fish “inspected” at escapement monitoring projects.

A two-stage parametric bootstrap simulation will be used to estimate variance and statistical bias in the estimator above, which will provide estimates of abundance at each upstream site (R_1, R_2, R_3, …, etc.).

If goodness-of-fit tests show evidence that equal capture probability assumptions were violated, then a Darroch stratified estimate will be used (*Objective 4*). The Stratified Population Analysis System (SPAS) program is one method of calculating and interpreting a Darroch stratified estimate (Arnason et al. 1996; for details refer to http://www.cs.umanitoba.ca/~popan/) which will be considered. Whether or not the stratified estimate is warranted due to failure to meet assumptions, it will still be used to provide estimates of population size and migration timing parameters for individual tributaries if possible. A recently developed maximum-likelihood based model provides a refinement of the stratified mark-recapture model (Bromaghin et al. 2010). This model allows migratory timing and capture probabilities to vary among temporal and spatial strata, as in a salmon run comprising an aggregate of population from several tributaries and spawning locations. The model combines three likelihood functions. The first models capture probabilities by stock and temporal stratum, assuming catch is proportional to effort and abundance in each stratum. The second likelihood function models the probability that tagged fish are successfully tracked and their identity (i.e. spawning location) is determined. The third function models the distribution of tagged fish whose identity is determined among the set of populations (i.e. tributary or spawning location) identified in the study area. Parameters are estimated for the abundance of fish in each population and proportion of each population that is present and available for capture during each temporal capture stratum (Bromaghin et al. 2010). The use of this model will be tested with the summer chum salmon mark-recapture data.

Stock Specific Run Timing, Migration Rates. Movement Patterns, and Distribution

Migration rates are determined as a function of kilometers between first RTS (gateway station) and upriver RTS sites based on the difference between the dates tagged and later recorded (*Objective 1*). Recovery project crews are required to record and report the individual tag number and date of catch for each fish. Stock timing is determined by comparing the dates of tag recovery by spawning location to the dates of release of those particular tags (*Objective 1*). Comparisons of individual fish timing can also be made with the overall stock timing from escapement projects to assess possible handling affects. Movement patterns of individual fish can be monitored along the mainstem Yukon River as individual fish pass by each radio tower (*Objective 1*). Movement patterns will be especially closely monitored after initial tagging to evaluate potential tagging or capture effects on behavior. Distribution of summer chum salmon will be determined by tower and aerial tracking (*Objective 1-2*). For a given terminal reach, the proportional number of summer chum salmon in that reach is the number of tagged fish located in the terminal reach divided by the total number of tagged fish that passed the gateway tower, assuming no stock specific mortality from tagging and capturing procedures. Important tributaries for spawning will be identified by comparing the proportion of tagged summer chum salmon in terminal reaches. The relative proportions and distribution, of tagged fish across terminal reaches can be used as a stock composition baseline that can be monitored in future years of tagging from sonar, weir, and tower counts (*Objective 2*). Changes in stock composition over time may indicate changes in productivity across stocks.

Protection of habitat used by anadromous fishes is provided to those specified water bodies listed in the anadromous waters catalog (AWC; Johnson and Daigneault 2013a and 2013b). Any new migratory or spawning location or extension of ranges determined from this project, based on the most current AWC, will be submitted for nomination for inclusion (*Objective 3*).

Evaluating Relationship of Anvik Sonar to Total Run Estimate

Currently, the total run size of summer chum salmon is estimated by the total Pilot Station sonar count plus harvest below the sonar. However, the ability to accurately count summer chum salmon at Pilot Station sonar can be hindered by high water, debris, large runs of pink salmon, or other conditions. The Anvik River sonar is less impacted by these factors and can provide a more reliable count estimate for summer chum salmon. The relationship of Anvik Sonar count to total run estimates based on Pilot Station sonar counts and harvest below the sonar has varied from 0.25 to 0.59 in the past 18 years. If the proportion of Anvik River stock, as determined by tag distribution, remains relatively constant over time, then Anvik River sonar counts can be used as an indicator of total run abundance (*Objective 5*). In order to reliably do so, we need to evaluate and try to understand the reason for variation in the relationship between the total run estimates – currently based on Pilot sonar counts and harvest below – and Anvik River sonar counts. A reliable estimate or index from the Anvik River would be useful to compare against the total run estimate based on Pilot Station sonar, in order to evaluate that sonar performance each year.

Evaluating Capture and Tagging Effects

Possible tagging or capture effects on behavior and survival of summer chum salmon could influence model and stock migration timing estimates if significant mortality or behavior modification occurs. Efforts will be made to minimize handling and stress when capturing and tagging fish. The chosen tag size is believed to minimize impact on summer chum salmon. Assessment projects downstream from the tagging site will be used to monitor potential migration downstream after capture and tagging. Additionally, time to the gateway station and entry in to the population for each tagged fish will be monitored to assess relative mortality or slowed migration due to handling and tagging.

SCHEDULE AND DELIVERABLES

The project began in May 2013 and continued through the summer of 2013 for tower repair and site setup and other preparations such as selecting and ordering tags and setting up the tracking database, for the first project year. Field data collection will commence in the spring of 2014, the second project year, beginning with seasonal activation of receivers. Tagging will begin with the summer chum salmon run in early June and continue through July; tracking will begin as soon as tagged fish are moving upriver and continue into September. This project is very data intensive and will require ongoing data entry, editing, and analysis through the duration of the project. A formal peer-reviewed report of project results will be written during the final project year, following the last season of data collection.

Dates	Activity
Apr.-Sep. 2013	Startup, ordering tags, complete position descriptions, and setup contracts and permits
May.-Sep. 2013	Repair and prepare towers, landing zones, and equipment

Jun.-Dec. 2013	Database programming, testing and preparation
Apr.-Jun. 2014	Field preparations and camp setup, hire tagging crews and mobilizing
Jun. & Sep. 2014 & 2015	Turn on/off remote tracking stations
Jun.-Jul. 2014 & 2015	Data collection-tagging
Jul.-Sep. 2014 & 2015	Data collection-aerial tracking
Jun.-Dec. 2014 & 2015	Data entry, downloads, verification and edits
Jan.-Jun. 2015	Data analysis
Jul.-Nov. 2015	Report writing
Jan. & Jul. 2013-2015	Submit progress reports biannually
June 2016	Submission of draft final report for peer review

RESPONSIBILITIES

List of Personnel and Duties:

Fishery Biologist IV-regional research coordinator will provide general oversight for the project, assist with budgeting and project administration, coordinate among staff in the Anchorage, Fairbanks, and field offices, and assist as necessary with project implementation, personnel, data analysis, and reporting.

Fishery Biologist III-summer season research biologist will be responsible for coordinating logistics, sampling, data processing, data analysis, inseason reporting and report writing.

Fishery Biologist II-summer season research assistant will assist with overseeing field operations and logistics, sampling, as well as prepare inseason daily data summaries for other research biologists, managers, and staff, will participate in aerial tracking, and will contribute to postseason data analysis and inseason reporting and report writing.

Fishery Biologist III-fall season research biologist and radio telemetry supervisor will be responsible for database management, data analysis and inseason reporting and report reviews.

Biometrician III-assists in preparation of statistical design of field investigation for operational plan, and reviews data analysis in the final report.

Fish and Wildlife Technician IV-trains all staff participating in handling, tagging, and tracking of salmon. Experienced in operating and maintaining Advanced Telemetry Systems used by Division of Commercial Fisheries.

Fish and Wildlife Technician III-field crew leader is responsible for maintaining consistency in tagging procedures throughout the project. Works closely with the local fishing captains and crews assisting with capture, sampling, and data collection. Will load data daily during tagging operations, , downloading of receivers from aircraft and stationary towers into the database as they occur and may participate in aerial tracking

Fish and Wildlife Technician II-will assist with capturing, sampling and data collecting.

Contracted Fishermen-two captains each with two crew members will provide local fishing knowledge and assist in capturing and tagging salmon.

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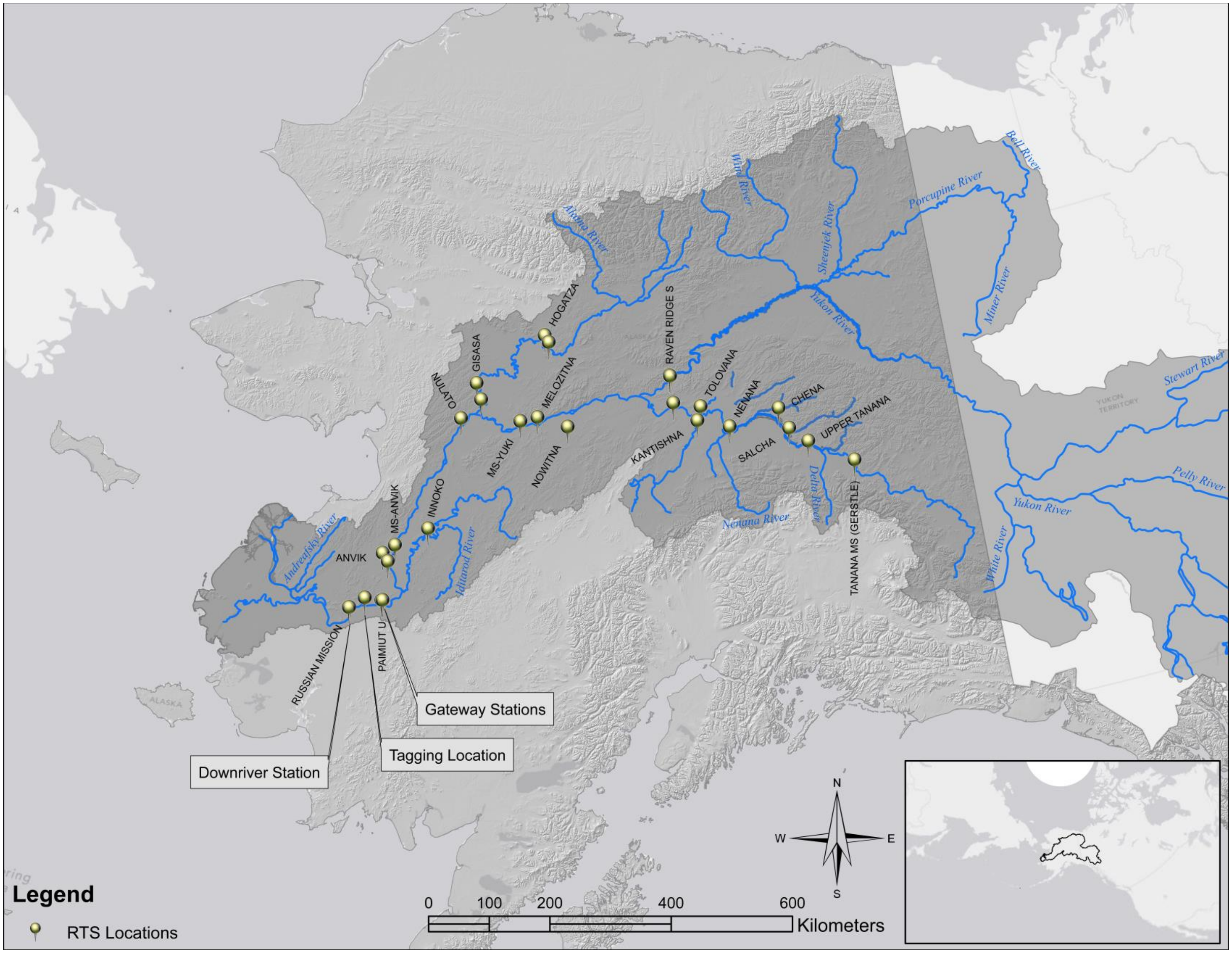
APPENDIX A

Appendix A1.–Map of Yukon River drainage indicating tagging location, names and locations of remote tracking stations (RTS), and river names, 2014.



Appendix A2.–Climate and hydrological observations form, summer chum salmon radio telemetry project, 2014.

Alaska Department of Fish and Game
Climatological and Stream Observations

Year: ______________ Station Name: ________________

Note: Should include two logs/lines per day one AM and one PM approximately 12 hours apart (military time).

Date	Time_Observed	Sky_Cover	Precipitation	Wind_Dir	Wind_Vel	Air_C	Comments	Water_C	W_Site

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Codes:		
Sky	Precipitation in 24 Hours	Wind Direction
0 no observation	A none	N, S, E, W, NW, SSW ect..
1 clear or mostly clear, <10% clouds	B intermittent	
2 cloud cover not more than 1/2 of sky	C continuous rain	Wind Velocity in (mph)
3 cloud cover more than 1/2 of sky	D snow	W_Site is site-
4 complete overcast	E snow and rain mixed	water temp collected
5 thick fog or haze	F hail	
	G thunderstorm with or without rain	

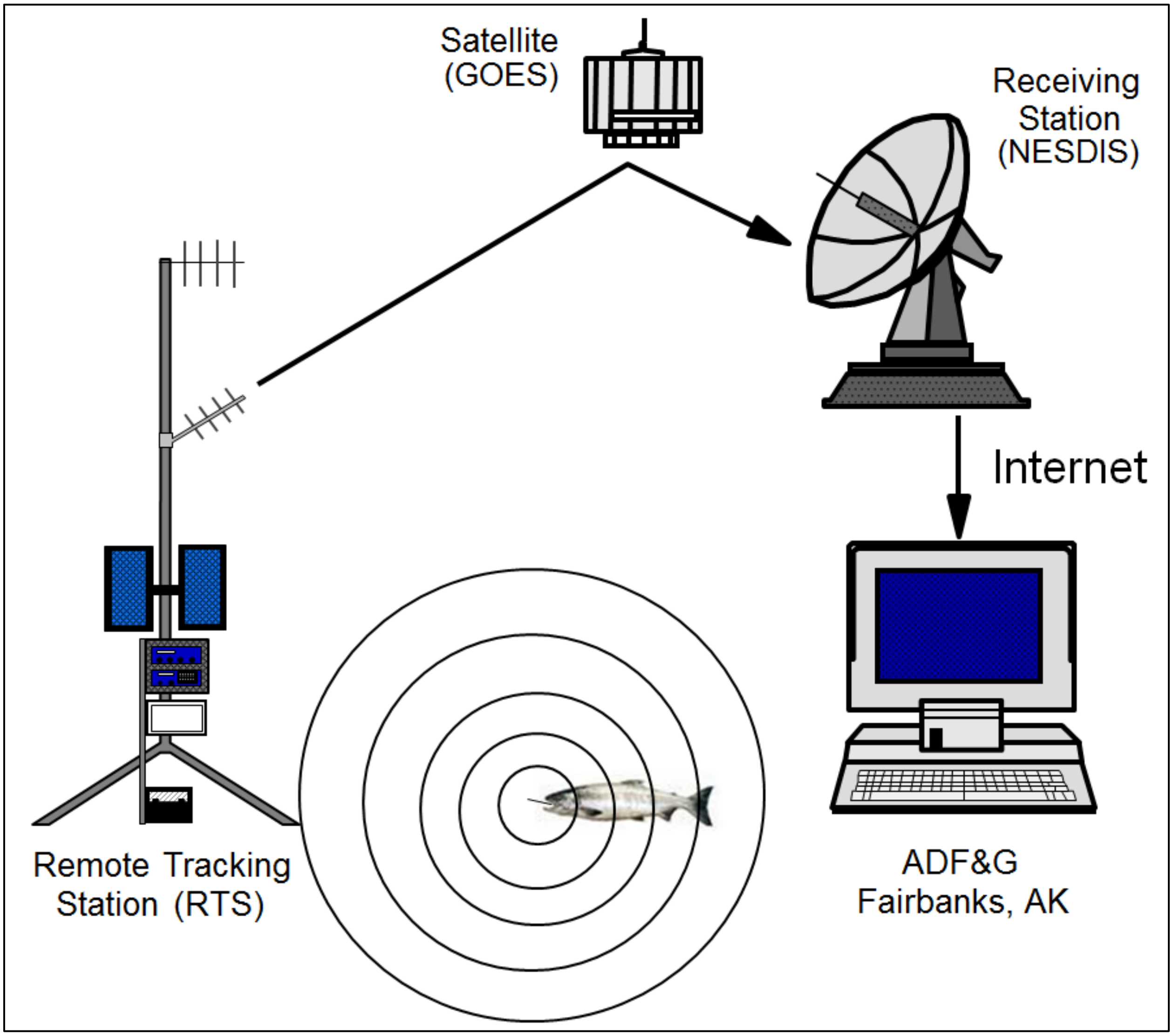
Appendix A3.–Deployment rate of radio transmitters (based on run timing from mainstem sonar estimates at Pilot Station) for summer chum salmon captured by drift gillnet at Russian Mission, 2014.

Date	Average Cumulative Day Percent	Cumulative Percent Estimate Per Week	Samples per Day n=1200	Samples per Week n=1200
12-Jun	0.01		7	
13-Jun	0.00		6	
14-Jun	0.01		8	
15-Jun	0.01		13	
16-Jun	0.01		17	
17-Jun	0.02		23	
18-Jun	0.03	8.59%	31	104
19-Jun	0.03		35	
20-Jun	0.03		42	
21-Jun	0.03		40	
22-Jun	0.04		50	
23-Jun	0.05		55	
24-Jun	0.05		55	
25-Jun	0.04	27.21%	53	330
26-Jun	0.05		57	
27-Jun	0.05		59	
28-Jun	0.05		61	
29-Jun	0.05		65	
30-Jun	0.05		56	
01-Jul	0.04		53	
02-Jul	0.04	33.06%	48	401
03-Jul	0.03		40	
04-Jul	0.03		36	
05-Jul	0.03		34	
06-Jul	0.03		31	
07-Jul	0.02		28	
08-Jul	0.03		30	
09-Jul	0.03	19.03%	30	231
10-Jul	0.02		25	
11-Jul	0.02		23	
12-Jul	0.02		22	
13-Jul	0.01		18	
14-Jul	0.01		13	
15-Jul	0.01		10	
16-Jul	0.01	9.81%	8	119
17-Jul	0.01		8	
18-Jul	0.01	1.31%	8	16
TOTAL	0.99	99.00%	1200	1200

Appendix A4.–Field names and descriptions of information to be recorded for each tagged fish for the database.

Field Name	Description of what will be recorded
study	Study number for identifying this unique project in database.
freq	Transmitter frequency (e.g. 150.863=863, 151.420=1420).
code	Transmitter code ranging from 00-99.
externalTag	External tag type (Floy).
externalTagNo	Identification number of fish based on external (Floy) tag number.
externalTagColor	Color of external tag (Floy).
species	Species: Chinook, chum, coho, sheefish, board whitefish etc…
sex	(1) M=male, (2) F=female, and (3) U=unknown/not determined
length	Length measured mid-eye to fork of tail to the nearest 1 mm.
weight	Weight of fish in pounds.
girth	Girth of fish as measured anterior of dorsal fin in mm.
fishColor	Fish color: 1=silver, 2=intermediate phases, 3=spawning coloration
tagger	Tagger identification.
taggerAffiliation	Agency of tagger.
comments	General observations relate to the fish selected for tagging.
handlingStartTime	Beginning of fish processing in military time hh:mm:ss.
releaseTime	Fish released after handling/tagging in military time hh:mm:ss.
tagReclaimedDate	Date tag was recovered. Used to end tracking events.
recapTagNo	External tag number of fish recaptured.
recapTagColor	Color of external tag of fish recaptured.

Appendix A5.–Remote tracking station and satellite uplink diagram used to collect and access movement information of chum salmon in the Yukon River study area.



Appendix A6.–Aerial survey radio tracking form, summer chum salmon radio telemetry project, 2014.

Telemetry Tracking Form

Receiver: ________ Method: __________________________ Date: __________

Name: ________________ Table: __________________________ Page: __________

FishNo	Hour	Freq	Code	Active	Area/Comments

Act: 1 - Active 2 - Inactive 3 - Inactive 24HR

Appendix A7.–Anticipated monitoring and escapement projects for recoveries of marked summer chum salmon, Yukon Area, 2014.

Km from Yukon River Mouth	Project Location	Project Type	Project Median Timing	Median Index Size	Range of Index	Years Included
	Projects Downstream of Tagging					
38	Emmonak Mainstem	Drift Gillnets	21-Jun	4,863	1,600-12,735	9
208	East Fork Andreafsky River	Weir	7-Jul	64,883	8,000-200,000	17
197	Pilot Station Mainstem	Sonar/Drift Gillnets	28-Jun	1,342,704	441,000-3,767,000	24
	Tagging Location					
365	Russian Mission Mainstem	Radio Tagging	-	-	-	-
	Projects Upstream of Tagging					
507	Anvik River	Sonar/Counting Tower	8-Jul	490,000	193,000-1,486,000	33
	Koyukuk River Drainage					
1,046	Gisasa River	Weir	11-Jul	37,395	10,000-261,000	18
1,809	Henshaw Creek	Weir	18-Jul	96,731	25,000-248,000	9
	Mainstem Yukon River					
1,169	Rampart Rapids	Fish Wheel [a]	27-Jul	4,082	580-23,000	12
1,931	Eagle Mainstem	Sonar/Test Fishery [b]	-	-	-	-
	Tanana River					
1,224	Manley Hot Springs Mainstem	Sonar/Gillnets/Fish Wheel [a]	26-Jul	2,947	2,000-4,200	4
1,481	Chena River	Sonar/Counting Tower	30-Jul	7,560	1,300-35,000	11
1,553	Salcha River	Counting Tower	2-Aug	30,784	5,800-193,000	13
1,553	Salcha River	Carcass Survey	14-Aug	-	-	-
0-1,931	**Catch Sampling**	Drainage-wide/Districts	-	-	-	-

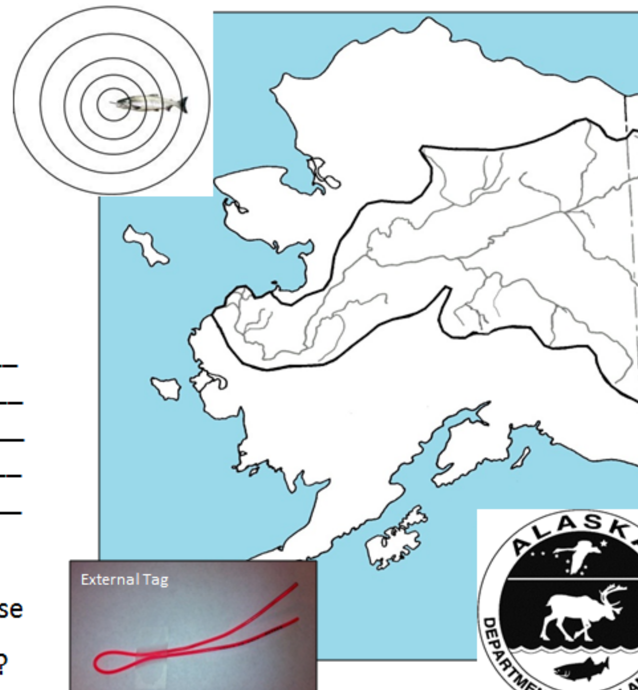
[a] Summer run based on annual operations from June startup to August 15, fall run goes through September.
[b] Typically fall chum salmon run in this area beginning mid to late August.

Appendix A8.–Public tag recovery form, summer chum salmon radio telemetry project, 2014.

Where do summer chum salmon go in the Yukon River drainage?
Radio telemetry can help answer important fishery management questions.

- Distribution in tributaries
    - Proportions compared to Mainstem sonar at Pilot Station
    - Relationship to Anvik sonar
    - Weir/tower/test fish monitoring
- Stock run timing
- Migration rates

Harvest + Escapement = Total Run Size

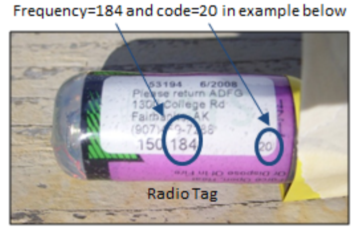


External Tag number: ______________ Color: ___________
Radio Tag Frequency: __________ Tag Code: ___________
Date Caught: _____________ Total Chum/Event: _________
Gear: Net/Mesh_________, Fish Wheel, Other___________
Capture Location: _______________________________
Gender of fish (circle one): M or F or Unknown
Radio tag found (circle one): Inside or Outside of Fish?
Fishery (circle one): Subsistence – Commercial – Personal Use

Provide contact info if you want the results from your fish?
Name: ____
Phone Number: ________________________
Mailing Address ___________________________________
City __________________ State ______ Zip code ________

Agency Information:
Date Recorded: ____________________________
Print Name of data recipient: _________________________

Frequency=184 and code=20 in example below



Division of Commercial Fisheries
Anchorage 907-267-2104
Fairbanks 907-459-7274
(Collect Calls Accepted)
stephanie.schmidt@alaska.gov
or return to traditional council

Appendix A9.–Monitoring project tag recovery form for handling fish, summer chum salmon radio telemetry project, 2014.

Alaska Department of Fish and Game Salmon Radio Tag Recovery Data Form

Project Name/Location: ______________________ Date (mm/dd/yy): ________________

Use new sheet each day

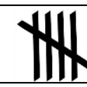
Start Time: _____________ Stop Time: __________ Gear Type: ____________

Total Number Fish Examined in Time Period (including tagged fish): ____________

External Tag Number	External Tag Color	Gender M/F/U	Length	Recovered Radio Y/N	Radio Tag Freq & Code	Species	Comments

Note: Instructions for completing form on back.

Appendix A9.–Page 2 of 2.

Instructions to Complete Tag Recovery Forms	
Field Name	**Description of what will be recorded**
Project Name/Location	Name of project eg. Weir/Henshaw Creek
Date	mm/dd/yy
Start/Stop Time	Start /Stop Time used to determine time increment of fish observation. (Military time hh:mm)
Gear Type	Gear type used to examine fish eg. trap, tower, drift gillnet, set gillnet, fish wheel
Total Number Fish Examined	Number of fish examined in the time period (inlcuding tagged fish).
External Tag Number	Number on external floy tag.
External Tag Color	Color of external tag. Eg. Y=yellow, P= pink, or G=green
Gender	(1) M=male, (2) F=female, and (3) U=unknown/not determined
Length	Mid-eye to fork of tail in nearest millimeter.
Recovered Radio	Yes or No was radio tag recovered (handling fish on spawning grounds).
Radio Tag Freq & Code	Record frequency = 150x.xxx and code xxx of the recoverd tag (for tracking purposes).
Species	Species: Chinook, chum, coho, sheefish, board whitefish etc…
Comments	Radio Tagged Fish Condition: Did the fish have wounds, sores, fungus? Was it energetic or lethargic? Color: Describe the fish coloration as 1=Silver, 2=Watermarked, 3=Spawning Colors. **If fish is handled on a spawning ground, gently pull the radio tag out by the antenna and return to ADFG. Leave external tag on fish but record number before removing radio tag.**
Number of Tags Observed by color	Number of tags observed passing when not handling fish and collecting tag numbers. Use tally marking for Appendix A10. 

Frequency=184 and code=20 in example below

Appendix A10.–Monitoring project tag recovery form for project not handling fish, summer chum salmon radio telemetry project, 2014. Includes tag colors from other 2014 mark-recapture projects in the Yukon River drainage.

Alaska Department of Fish and Game Salmon Radio Tag Recovery Data Form

Project Name/Location: ____________________ Date (mm/dd/yy): ____________________

Use new sheet each day.

Start Time: ________	Stop Time: ________		Gear Type: ________
Species: ________	Total Number Fish Examined in Time Period (including tagged fish): ________		
Orange Total	Yellow Total	Light Green Total	Red Total
Pink Total	White Total	Dark Green Total	Blue Total
Start Time: ________	Stop Time: ________	Total Number Fish Examined: ________	
Orange Total	Yellow Total	Light Green Total	Red Total
Pink Total	White Total	Dark Green Total	Blue Total
Start Time: ________	Stop Time: ________	Total Number Fish Examined: ________	
Orange Total	Yellow Total	Light Green Total	Red Total
Pink Total	White Total	Dark Green Total	Blue Total
Start Time: ________	Stop Time: ________	Total Number Fish Examined: ________	
Orange Total	Yellow Total	Light Green Total	Red Total
Pink Total	White Total	Dark Green Total	Blue Total

Appendix A11.–Field names and descriptions of information to be recorded for each drift made to capture fish for tagging.

Field Name	**Description of what will be recorded**
capEventID	Unique ID for relating boat outing from camp to capture data.
capEventDate	Date of fish capture mm/dd/yy.
captain	Boat captain designation.
captureMethod	Capture method using gear code: fish wheel, set gillnet, drift gillnet etc…
capSite	Capture site (drift site) designation and latitude/longitude.
lat	Latitude of drift in decimal degrees (e.g. 61.90461)
long	Longitude of drift in decimal degrees (e.g. -161.04881)
remarks	General observations relate to the capture event.
driftNoID	Unique ID for relating fish captured to net information for catch per unit effort.
meshSize	Mesh size of gear in decimal (e.g. 4.25).
depth	Number of meshes deep.
length	Net length fished in fathoms.
startOut	Time gillnet Start Out (military time hh:mm:ss)
stopOut	Time gillnet Full Out (military time hh:mm:ss)
startIn	Time gillnet Start In (military time hh:mm:ss)
stopIn	Time gillnet Full In (military time hh:mm:ss)
speciesID	Unique ID for species: Chinook, chum, coho, sheefish, board whitefish etc…
countMale	Count of all male salmon captured regardless if to be tagged.
countFemale	Count of female salmon captured regardless if to be tagged.
countUnknown	Count of unknown sexed salmon captured regardless if to be tagged.